NATURAL HISTORY ILLUSTRATIONS.

PREPARED UNDER THE DIRECTION OF LOUIS AGASSIZ. 1849.

THE ANATOMY

OF

ASTRANGIA DANÆ.

SIX LITHOGRAPHS FROM DRAWINGS BY A. SONREL.

EXPLANATION OF PLATES BY J. WALTER FEWKES.

CITY OF WASHINGTON:
PUBLISHED BY THE SMITHSONIAN INSTITUTION.
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ADVERTISEMENT.

The present publication, though the mere fragment of a memoir many years ago undertaken by the eminent naturalist, Professor Agassiz, is at last offered to biologists in its imperfect state, in the belief that even in this form, and at this late day, it will be welcomed by many students who would be reluctant to have the fruit of worthy labor wholly lost to the world.

The scope of the brief abstract, and the circumstances occasioning the unusual delay in its appearance, will be sufficiently explained by the following statement received from Mr. Alexander Agassiz:

"The plates of Astrangia were drawn by Mr. Sonrel, under Professor Agassiz's direction, as far back as 1849. The material was collected during the first dredging trip undertaken by Professor Agassiz under the auspices of the United States Coast Survey. Professor A. D. Bache, then Superintendent of the Coast Survey, invited Professor Agassiz to join the United States Coast Survey steamer 'Bibb,' commanded by Lieutenant Charles H. Davis, afterwards Rear Admiral, and to undertake a dredging trip in the vicinity of Nantucket. Among other material, numerous bunches of Astrangia were collected by the 'Bibb.' These were kept alive at Cambridge for nearly a year. During that time some drawings were made towards illustrating the anatomy of the genus. The completion of the memoir was delayed in the hopes of adding the developmental history of the genus, but after the first year of preparation Professor Agassiz never again had the opportunity of taking up the subject. The plates therefore remained unpublished in the hands of the Smithsonian Institution. The last year of his life Mr. Louis F. Pourtalès undertook the completion of the work at the Newport Marine Laboratory, but he only brought together the necessary materials, and left neither notes nor drawings for publication. At the request of Professor Spencer F. Baird, Secretary of the Smithsonian, Mr. J. Walter Fewkes has written an explanation of the plates to make them available to students of marine invertebrates."

S. P. LANGLEY,
Secretary of the Smithsonian Institution.

Smithsonian Institution,
Washington, D. C., *February*, 1889.

PREFACE.

The plates of this atlas were drawn on stone several years ago under the direction of Prof. Louis Agassiz. At the request of Mr. Alexander Agassiz explanations of the figures have been written out for the accompanying plates. In order to fit myself for a better understanding of the anatomy of Astrangia, live animals have been used in conjunction with the plates in the preparation of the explanations. This part of the work has been done at the Newport Marine Laboratory. Since the work came into my hands the publication has been delayed in the hope of adding to it something on the development of Astrangia; but, although I have succeeded in getting the ova of this coral, I have thus far failed to add anything to the much-needed embryology of this animal. Lest the plates should become antiquated, it has seemed best to delay no longer their publication, but to print them in the form originally prepared by Prof. Agassiz. The reader is reminded that there has been a great advance in histological methods since the figures were drawn. In that advance, however, little has been added to the knowledge of the minute anatomy of genera of Madreporaria allied to Astrangia.

J. WALTER FEWKES.

Museum Comparative Zoology,
Cambridge, Mass.

INTRODUCTORY NOTICE.

The sole representative of the Madreporaria in shallow New England waters is the genus Astrangia. One species of Astrangia has been found in New England, and has been mentioned or described by Louis Agassiz, Leidy, Alexander Agassiz, Verrill, and others. It is referred to by Leidy as *A. astræformis*, M. E. & H., by L. Agassiz, A. Agassiz, and Verrill as *A. Danæ*.

Astrangia is found along the eastern coast of the United States and occurs in the southern limits of the New England fauna, south of Cape Cod. It occurs in shallow waters of Long Island Sound, Narragansett Bay, Buzzard's Bay, and Vineyard Sound. Its northern limits are the waters adjoining the southern end of Cape Cod.

The genus is often found in crevices of the rocks and on the sides of cliffs, just below low tide, from which places it ranges into shallow-water dredgings, and is apparently found in great numbers in its favorite haunts. Astrangia seems to prefer a rocky to a sandy bottom. While it is generally found in the form of incrustations on the rocks and dead shells, it sometimes rises in low, club-shaped branches. In aquaria it is hardy and easily kept alive in pure water. It devours greedily small crustacea, fishes, fragments of beef, and other forms of meat, and is far from fastidious in its preferences. Small live animals, as fishes, are easily killed by its nematocysts, provided the prey be held in the neighborhood of the tentacles.

The specimens which I have studied were found on Price's Neck, a small peninsula on the southern extremity of the island of Rhode Island, not far from the Newport Laboratory. Clumps of colonies are easily broken from the rocks at low tide, where these animals live in company with a rich littoral life.

The color of the expanded Astrangia is white, almost transparent, resembling an Edwardsia or small white actinia. When contracted the color shows a green or bluish tinge. The motion in contraction is less rapid than in Edwardsia, and is often sluggish. When overfed it will not respond by contraction, even when touched or stroked with a foreign body.

The live Astrangia from New England was first observed by Prof. Louis

Proc. Amer. Assoc., 1849.

Agassiz,* who dredged it in nine fathoms off Gay Head, Vineyard Sound. Agassiz referred it to *A. Danæ*, M. E. & H., a coral, the hard parts only of which were known up to that time.

The polypidom of *A. Danæ*, M. E. & H., is held by Prof. Joseph Leidy to be different from that of our New England species of Astrangia and more like the *A. astræ(i)formis* of the same authors. The present plates were made from the coral which Agassiz designated as *A. Danæ*, and the specific name which he used is here adopted.

It is not possible to determine from the description of *A. Danæ* given by Milne Edwards and Haime whether our species differs from that which they describe under that name or not.

The following description of *A. Danæ* is given by Milne Edwards:*

"Polypiérites très-courts, unis entre eux par une expansion très-mince et faiblement striée. Côtes très-larges, alternativement un peu plus fortes et plus petites, distinctes des la base, à fossette grande et mèdiocrement profonde. Columelle très-developpée, a papilles crépues et granulées, 3 cycles complets; quelquefois dans une des moities d'un système, ou voit des cloisons d'un 4[e] cycle cloisons un peu débordantes, à bord fortement arque en haut, à faces couvertes de grains pointus et très-saillants, ayant leurs dents les plus fortes pres de la columelle. Hauteur des polypiérites, 3 ou 4 millimètres; diamèter des calices, 4 ou 5; profundeur des fossettes, 2.

"Patrie inconne."

Of *A. astræiformis* the last-mentioned author gives the following description:

"Polypiérites très-rapprochès et soudés entre eux pas les points ou ils recoutret. Muraille à peine costulée et seulement près du calice. Calices circulaires quand ils sont libres, subpolygonaux dans les points du polypier où ils sont serrés à fossette grande, profonde et infundibuliforme. Columelle peu developpé. 3. cycles; souvent des cloisons d'un quatrième cycle se moutretet dans une des moities des systèmes cloisons peu débordantes, très-étroites en Naut, à bord oblique et regulièrement dente en scie; les dents inferieurs à peine plus fortes que les autres. Les grains des faces latérales sont très-peu saillants. Hauteur, 3 ou 4 millimetres; diamètre des calices, 4. Habite les côtes des Etats-Unis."

Prof. Joseph Leidy regards the *A. Danæ*, Ag., as the same as *A. astræformis*, M. E. & H., and gives the following description:†

"Polypidom encrusting flat or lobed, or pedicled and lobed; polype cells short, approximate, fused together at their bases, cylindrical when free, sub-

* Histoire Naturelle des Corallaires ou Polypes proprement dits. Tome II, p. 612.

†*Journ. Acad. Nat. Sci. Phil.*, vol. III, second series, 1855, pp. 7, 8.

polygonal when crowded, externally slightly costate; calices infundibular; columlella slightly developed; partitions up to thirty-five in number, slightly exserted, narrow, with their margin oblique and serrated and their sides denticulated; polypes cylindrical, projecting up to half an inch in length, translucent white, brown, red, or green; tentaculæ colorless, twenty-four in number, elongated conical, with rounded tips, situated in an alternating circle; mouth oval, situated at the summit of a conical proboscis; coral masses up to two inches in diameter."

PLATE I.

EXTERNAL FORM.

Fig. 1.—Colonies showing the animal expanded and contracted. Life size.

α. Club-shaped cluster. *β*. Cœnenchyma between two animals. *γ*. Animal expanded. *β*. Encrusting colony.

Fig. 2.—Similar colonies from another cluster. *β*. Club-shaped colony.

Fig. 3.—Basal calcareous deposit. Live parts wanting. Colony attached to a Pecten shell.

Fig. 4.—Colonies in which the individual animals are somewhat isolated and the basal deposit ess polygonal than in many specimens of *A. Danæ*. *α*, *β*. Two colonies.

Fig. 5.—Calcareous radial deposits of the basal region of three contiguous animals. The septa are of different lengths (cycles?), extending from the periphery towards the center. a, b, c. Position of interseptal mesenteries and chambers. 8 diameters.

Fig. 6.—Appearance of the calcareous deposits (cycles) when first secreted, arranged in concentric rings. 3 diameters.

Fig. 7.—Several animals, retracted. *α*, *β*. Lateral buds. 3 diameters.

Fig. 8.—Several animals in different attitudes of expansion or contraction. The central animal shows the maximum amount of contraction, the soft parts being so withdrawn that mouth and bounding wall of the periphery of the animal lie in approximately the same plane. In all the other polypites the tentacles are drawn in, but the conical form of the columnar portion of the body is still retained.

a. Mouth. a′. Peristoma, a conical region of the disk between the mouth and the ring of tentacles infolded in the animal, centrally placed and hidden under the soft parts of the columnar region. g. Junction of basal and columnar region. h. Basal region. i. Columnar region. 8 diameters.

Fig. 9.—Single animal isolated from a colony.

α. Mouth., *β*. Buds which later form new animals. These last structures are possibly new tentacles. *α*. Structures which arise in a position homologous to that of a tentacle, while *β* lies in the position which it would naturally have if it were a bud destined to become a new individual.

Fig. 10.—Lateral view of a single animal with the tentacles beginning to form.

a. Mouth. d. External peripheral wall.

Fig. 11.—The same with closed mouth (a).

Fig. 12.—The same with mouth (a) in the form of an elongated slit.

Fig. 13.—Apex of the oral prominence, with the mesenteric septa showing through the body walls

a. Mouth. i. Chamber of the column.

Fig. 14.—The same as last with reniform mouth (a).

i. Body wall of a radial chamber.

Fig. 15.—The extended columnar region with half-protruded tentacles (d).

Fig. 16.—Attitude assumed when the oral prominence and tentacles are drawn into the columnar region of the animal.

d. Tentacles half retracted. g. Point of division between the base of the columnar region of the animal and its basal region. h. Basal chamber of the flat region of the body. 12 diameters.

Fig. 17.—Same as Fig. 16, with the columnar region partially retracted and the column constricted midway in height.

a. Mouth. Other letters as in Fig. 16.

Fig. 18.—Diagram showing the relative positions of large and small tentacles and the mouth. Compare with Fig. 5 (lettering a, b, c) for relation of the tentacles to the calcareous septa. The oblong central opening represents the mouth.

a. Eight large tentacles (first formed?). b. A second series. c. A third series. It is difficult to determine what was intended to be represented by the above diagram. The same lettering in Fig. 5 represents chambers between calcareous deposits. As such chambers correspond in position with that of the tentacles, it is supposed that the peripheral ring in Fig. 18 represents the relative positions of these bodies.

PLATE II.

EXTERNAL FORM.

Fig. 1.—Single animal from the oral side.

a. Mouth. a′. Peristoma or oral prominence. d. Tentacle. h. Basal region. 5 diameters.

Fig. 2.—The same turned to one side, so that it is seen from the oral and lateral region. The tentacles are retracted.

d. Tentacle. h. Retracted columnar region. g. Region of junction of columnar and basal region, basal chambers.

Fig. 3.—Animal from oral side, with the tentacles partially withdrawn. Mouth (a) assumes a sinuous form.

d. Tentacle. g. Chambers, basal region.

Fig. 4.—The oral prominence, mouth (a), and tentacles (d). The other soft parts of the body are not represented.

Fig. 5.—The lettering of this figure is not wholly evident. There seems no doubt that the central opening (a) is a mouth, through which may be seen unknown structures which may be the tips of tentacles.

g. Chambers of column. h. Centrifugal and centripetal ends of the chambers.

Figs. 6–10.—Various forms assumed by the mouth or oral slit (a) in different condition of contraction of the lips and peristoma.

Fig. 11.—Side view of the oral protuberance, or peristome, and tentacles. The mouth is represented as open.

a. Mouth. d, d. Tentacles.

Fig. 12.—Side view of a retracted animal. The mouth and oral prominence is partially drawn into the central region enclosed by the inner wall of the columnar region. The tentacles are so retracted that their tips only (d, d) are seen. At h the outer wall of the chambers in the basal region is indicated.

Fig. 13.—View of the base of a single animal. Mouth (a) showing the tentacles (d) at their very tips. g. Columnar chambers. h. Chambers of the peripheral region.

Fig. 14.—Lateral and oral view of the oral region, showing an oral prominence slightly protruding.

d. Tentacle. The mouth (a) is at the apex of the peristoma. g. Chambers of the column showing septa.

Fig. 15.—Septal and radial mesenterial divisions of the body.

a. Mouth. g. Basal region, chambers. h. Peripheral region.

Fig. 16.—The peristoma retracted and mouth open. The tentacles are hidden by the lobes of the column, although the tips of two of these organs are seen just above the mouth (a), g, and h, as in Fig. 15.

Fig. 17.—Inflated condition of the chambers, by which the mouth is hidden.

a. Position of mouth. a′. Inflated chamber. d. Tentacle. Alternate tentacles are foreshortened and appear spherical or circular.

Fig. 18.—Animal half contracted, seen from a latero-oral view. The tips of the tentacles (d) project beyond the inner rim of the contracted column.

g. Basal chamber. h. Basal mesenteries.

Figs. 19, 20.—Oral view showing folds of the column in contraction.

a. Mouth. g. Basal region. h. Peripheral region.

Fig. 21.—Profile view of the peristoma and mouth.

a. Mouth. a′. Peristoma. The dotted lines end at two intermesenteric chambers.

Fig. 22.—Mouth and tentacles in relative position to each other.

Fig. 23.—Mouth and tentacles with inflated intermesenteric chambers.

Fig. 24.—Junction of the columnar and basal regions. Animal retracted. Tentacles (d) simply indicated.

a. Mouth. g. Point of junction of the columnar and basal region.

Fig. 25.—Oral view of an expanded animal, showing the relation of the bases of the tentacles to the interseptal chambers.

a. Mouth. a′. Peristoma. d. Tentacles. e. Bases of tentacles and junction with chambers.

Fig. 26.—Enlarged view of a contracted animal with inflated peristoma. The tentacles are hidden between the wall of the oral prominence and the inner rim of the column. The tips of a few of these structures (tentacles) can be seen on the left-hand side in the ring-formed fossa.

a. Mouth. a′. Peristoma. g. Chambers. h. Septum.

Fig. 27.—A mesenteric filament (f) showing through the mouth opening.

d. Tentacle. g. Column. h. Peripheral region.

Fig. 28.—Peristoma and tentacles. a′. Peristoma. Two of the tentacles are bent to show their shape, while others appear in perspective.

Fig. 29.—Contracted animal with tentacles removed or hidden by inflated walls of the chambers.

a. Mouth.

Fig. 30.—A contracted cluster of coral animals, showing the fusion of the chambers in two individuals in the two lower members. All contracted.

a. Mouth. g. Columnar region. h. Peripheral chambers.

Fig. 31.—A cluster of expanded animals.

a. Mouth. d. Tentacles. g. Basal region. h. Coenosarc and basal fusion of two animals.

PLATE III.

EXTERNAL FORM.

Fig. 1.—Lateral view of the upper part of an animal showing expanded tentacles.

a. Mouth. b. Constricted region of the digestive tract. c. Stomach. d. Tentacles. l. Junction of the tentacles and radial chambers.

Fig. 2.—Expanded animal from oral side.

a. Mouth. d. Tentacle (?). e. Communication between the cavity of a tentacle and a radial chamber.

Fig. 3.—Two tentacles. e. Junction of the base of the tentacle with the body wall and chamber.

Fig. 4.—Oral view, similar to that shown in Fig. 2, with same lettering.

Fig. 5.—Lateral view of the column, upper extremity. Tentacles (d) drawn together about the mouth.

Fig. 6.—Lateral view of an animal with partially extended tentacles.

a. Mouth. b. Constriction of stomach. d. Tentacles.

Fig. 7.—Column.

a. Mouth. b. Oral constriction. c. Cavity. g, h. Basal region.

Fig. 8.—Attitude assumed by animal in which the tentacles (d) are turned in towards the mouth and a constriction separates columnar and basal regions.

Fig. 9.—Expanded animal with contracted tentacles (d).

b. Constriction. c. Cavity. g, h. Basal region.

Fig. 10.—Column of an expanded animal from one side.

a. Mouth. d. Tentacles.

Fig. 11.—Partially contracted animal in which the tentacles are represented as being withdrawn into the cylinder of the column.

f. Mesenteric filament. g, h. Basal region. i. Chamber.

Fig. 12.—The oral prominence (peristoma) from one side.

a. Mouth. b. Oral constriction. c. Stomach or external wall. From the letters a and b I should suppose c was used to designate the stomach. In Fig. 14, however, it may be simply the external wall of the column.

Fig. 13.—Expanded animal with tentacles (d) half protruded, but with peristoma retracted.

a. Mouth. b. Oral constriction. c. Cavity. f. Mesenteric filament. g, h. Basal region of animal.

Fig. 14.—The upper part of the column of a fully expanded animal.

a. Mouth. c. Body wall of the column. d. Tentacle.

PLATE IV.

INTERNAL ANATOMY.

Fig. 1.—Section (horizontal) showing the tentacles retracted but not withdrawn from sight.

a, b, c. Tentacles. d. Septa. e, f. Wall separating the bases of the tentacles. g. Wall connecting the axial ends of the septa. h. Ciliated passage from stomach into the lower cavity of the body, in which mesenteries are found.

Fig. 2.—An extremity of a tentacle showing the terminal cluster of nematocysts (a) and lateral clusters (b). Tentacle somewhat retracted.

Fig. 3.—Lateral view of a tentacle.

a. Terminal cluster of nematocysts. b. Lateral clusters. c. Muscular (longitudinal) fibres which move the tentacles. d. Septa. 1 (?), f. Superficial epiblastic cells.

Fig. 4.—An enlarged end of a tentacle showing the cluster of terminal nematocysts (a) and the lateral clusters (b). The tentacle is contracted?

Fig. 5.—A similar tentacle elongated. Lettering as in Fig. 4.

Fig. 6.—A view of a section (horizontal) in which the opening (h) is contracted. Lettering as in Fig. 1.

Fig. 7.—Distal extremity of a contracted tentacle.

PLATE V.

HISTOLOGY OF THE TENTACLE.

Fig. 1.—Distal (free) end of a tentacle.

a. Terminal cluster of nematocysts. b. Lateral clusters.

Fig. 2.—The same showing the threads extended from the nematocysts in both terminal and lateral clusters.

a, b. Terminal and lateral clusters of nematocysts. c. Extended threads. d. Superficial ciliated layer. e. Hypoblast.

Fig. 3.—Distal cluster of nematocysts.

Fig. 4.—A tentacle with discoidal tip.

Fig. 5.—Abnormal tentacle. The tip is bifurcated and there are two termimal clusters of nematocysts.

Fig. 6.—A tentacle with disk-shaped cluster of nematocysts.

Fig. 7.—A cluster of nematocysts from an unknown region of the body.

Figs. 8, 9.—I am unable to interpret these figures.

PLATE VI.

NEMATOCYSTS.

The following quotations from Prof. J. Leidy, *op. cit.*, may serve as an introduction to a study of the figures here given of the nematocysts found in Astrangia. He says:

"The filiferous capsules (nematocysts) of *A. astræformis* are of two principal varieties. The first variety consists of oval or ovoidal cells .05 mm. long by .0155 mm. broad, containing a spirally-wound thread. . . . The second variety consists of smaller cells, those of the tentaculæ measuring about .045 mm. by .0067 mm. and those of the white cords .03 mm. by .0112 mm.; and they contain besides a spirally-wound thread a style extending from one pole to about the centre of the cells. . . . Both kinds of filiferous capsules, under certain circumstances not readily explained, eject their contained thread with an astonishing degree of rapidity, and in so doing the threads are absolutely turned inside out, as was first noticed by Agassiz and subsequently by Gosse, and remain attached to the emptied cells as long-extended tubes. From the smaller cells the style is also extruded and then appears as a more expanded portion of the thread, with which it is continuous at one end and with the capsule at the other. . . . An attentive examination of the extended thread exhibits a more complicated structure than would have been suspected, and, as remarked by Agassiz, who first detected the peculiar arrangement, its exact character is exceedingly difficult to ascertain and requires the utmost power of the microscope to analyze. In the case of the larger capsules a spiral arrangement is readily distinguishable, extending the entire length of the extruded thread. This arrangement, in some instances, appeared to me to depend on minute ciliæ, which project at right angles from the thread and apparently pursue a spiral course, as described by Agassiz and as represented . . . but in other instances it appeared to me as if the thread during its eversion from the capsule assumed a spiral course within the portion preceding it, and that the thread externally at regular intervals with non-vibrating ciliæ . . .

"In the case of the smaller capsules the extruded style appears as a tube much dilated beyond its original calibre, narrowed at the extremities and longer than the cell which contained it, so that it appears to have been folded within itself. From the distal extremity of the stylous tube projects the everted thread, which at times appeared simple but at other times appeared to possess a spiral arrangement, like the coarser thread of the larger capsules. The tube derived from the style also presents a spiral arrangement apparently dependent upon long ciliæ pursuing a spiral course, as represented in figure 16, or upon a twisting in the tube, as represented in figure 15."

The above description, the most complete which we have of the structure of the different kinds of thread-cells, or nematocysts, found in Astrangia, is from Dr. Leidy's well-known paper on the marine invertebrate fauna of the coasts of Rhode Island and New Jersey.* This description was published in 1855, before histological study had attained the development which it has in the present time.†

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* Contributions towards a Knowledge of the Marine Invertebrate Fauna of the Coasts of Rhode Island and New Jersey. By Joseph Leidy, M. D. *Journ. Acad. Nat. Sci. Phil.*, Vol. III (second series).

† As Mosely has well said in his report on the hydroid, alcyonarian, and madreporarian corals of the Challenger expedition, "It would seem that a classification and nomenclature of the various forms of thread-cells is much needed, since these forms appear to be of classificatory value in the Coelenterata." The Voyage of H. M. S. Challenger. Zoology. Report on certain Hydroid, Alcyonarian, and Madreporarian Corals procured during the voyage of H. M. S. Challenger in the years 1873–1876, p. 29, note.

HISTOLOGY OF THE NEMATOCYST.

Fig. 1.—Stroma from the epiblast, with large and small nematocysts in various conditions of growth. The nematocysts of the hydrocorallinæ, according to Moseley, "appear to be developed out of the nucleus of the ectodermic cells, the ectodermal cell becoming much enlarged and forming a wide chamber in which the process of development takes place. The ovoid nucleus becomes enlarged, together with the cell, but not at all in the same proportion, the cell always appearing as a wide cavity around it. The nucleus as it enlarges has a rounded nucleolus developed at one end of it. The nucleolus has large granules developed within it, whilst the nucleus becomes finely granular. In the next stage one large coil of the thread appears in the nucleus." From the similarity of the fully grown and cell in Astrangia and some of the nematocysts of the hydrozoan hydrocorallinæ it is thought that a similar development occurs in Astrangia.

a. Oval nematocyst. b. Club-shaped nematocyst. c, d. Nuclei.

Fig. 2.—Club-shaped nematocyst.

a. Cell wall. b. Style. c. Thread.

Fig. 3.—Oval nematocyst.

Figs. 4, 5.—Club-shaped nematocyst.

Fig. 6.—Inflated oval nematocyst with coiled thread.

Fig. 7.—Two nematocysts with fully and partially protruded threads.

Fig. 9.—Nematocyst with coiled thread retracted in cell.

Fig. 10.—Distal end of the thread coiled into a conical spiral.

Fig. 11.—Elongated oval nematocyst with thread coiled internally. a. Cell wall.

Fig. 12.—Nematocyst with partially extruded thread and with the retained portion irregularly coiled.

a. Cell wall. b. Inflated region with "stiff cilia," or "spines."

Fig. 13.—Nematocyst with retracted thread. Lettering as above.

Fig. 14.—Elongated oval nematocyst.

Fig. 15.—Nematocyst with thread protruded but cut off just beyond the inflation which bears the "stiff cilia."

Fig. 16.—The same as last figure.

Figs. 17–21.—Different figures of the inflation of the thread, with spiral lines upon which the "stiff cilia" are borne.

Fig. 22.—

Fig. 23.—Small elongated cell with protruded thread.

Fig. 24.—Nematocyst with thread partially coiled in the cell and partially protruded.

Fig. 25.—Pyriform shape assumed by a nematocyst.

a. Cell wall.

Fig. 26.—Nematocyst with thread partially coiled in the cell.

Fig. 27.—Nematocyst with inflated base of the thread.

Figs. 28–31.—Different forms of the cell of a nematocyst with thread coiled within.
a. Cell wall. b. Style. c. Thread.

Fig. 32.—Small club-shaped nematocysts with nucleated cells.
a, a, a. Nematocysts. d. Cell nuclei.

Fig. 33.—Large nematocyst with thread withdrawn into the cell.
a. Cell wall. b. Style. c. Thread.

Fig. 34.—Nematocyst with thread protruded to its full length.
a. Cell wall. b. Basal inflation. c. Thread.

Fig. 35.—A portion of the basal inflation of the thread of a nematocyst highly magnified.

Fig. 36.—The same more extended.

Fig. 37.—Nematocyst with thread partially protruded.

Fig. 38.—Nematocyst with thread tightly coiled in the cavity.

Fig. 39.—Nematocyst with thread half protruded.
a. Cell wall. b. Basal inflation. c. Thread.

Fig. 40.—Nematocyst with the larger part of the thread protruded.

Figs. 41–50.—Different forms of the nematocyst.

Fig. 51.—Nematocyst with thickened superficial layer.
a. Thick layer. c. Coiled thread.

Fig. 52.—A similar cell with thread protruded. No basal inflation shown and thread very long.

Fig. 53.—Same with thread contracted into the cell.
a. Cell wall. b. Style. c. Coiled thread.

Fig. 54.—Nematocyst with thread partially retracted.

Fig. 55.—Nematocyst with thread protruded.

Fig. 56.—Basal inflation with spiral row of "stiff cilia."

Fig. 57.—A nematocyst and portion of the inflated base of the thread of the same.
a. Cell. b. Inflated base of the thread.

Fig. 58.—The same with "stiff cilia" on the basal inflation.

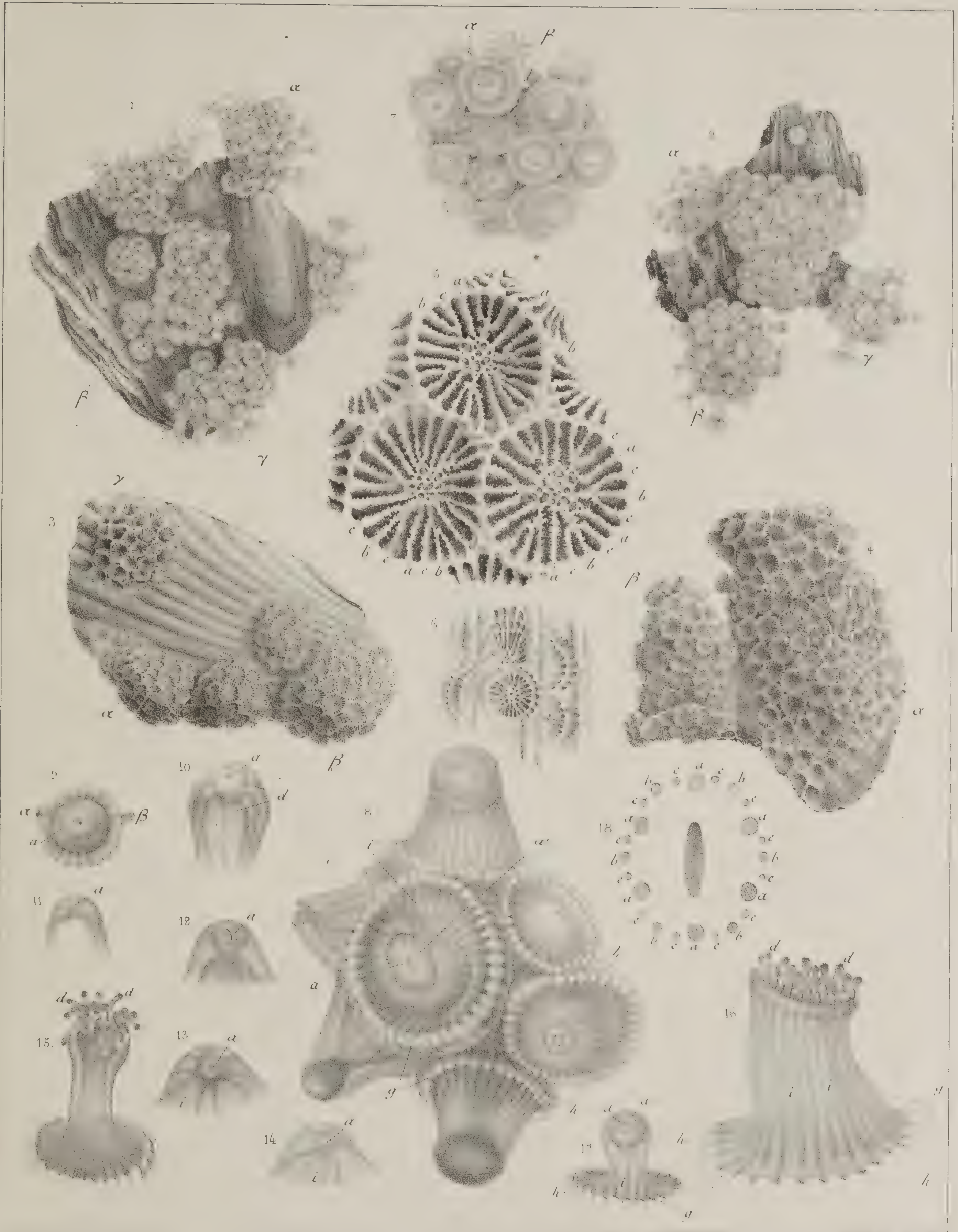
Fig. 59.—A portion of the coiled thread.

Fig. 60.—Row of "stiff cilia" from the spiral line of the basel inflation of the wall of the thread.

Fig. 61.—Nematocyst with partially coiled thread in its interior.

Fig. 62.—Nematocyst with the thread protruded.

Fig. 63.—Fully developed nematocysts with the thread retracted, showing them crowded together. Taken from an unknown region of the body.



A. Sonrel, on stone from nat.

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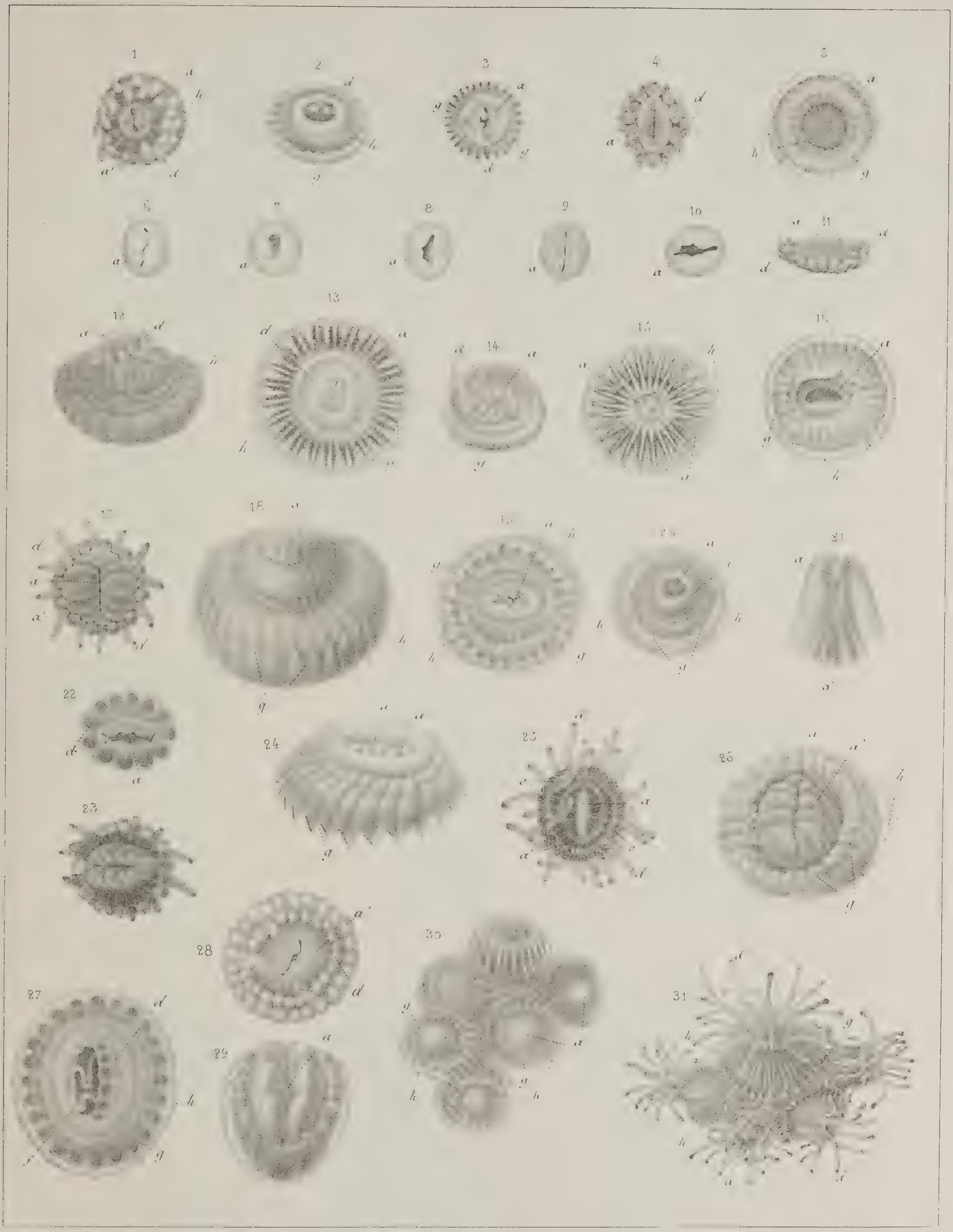
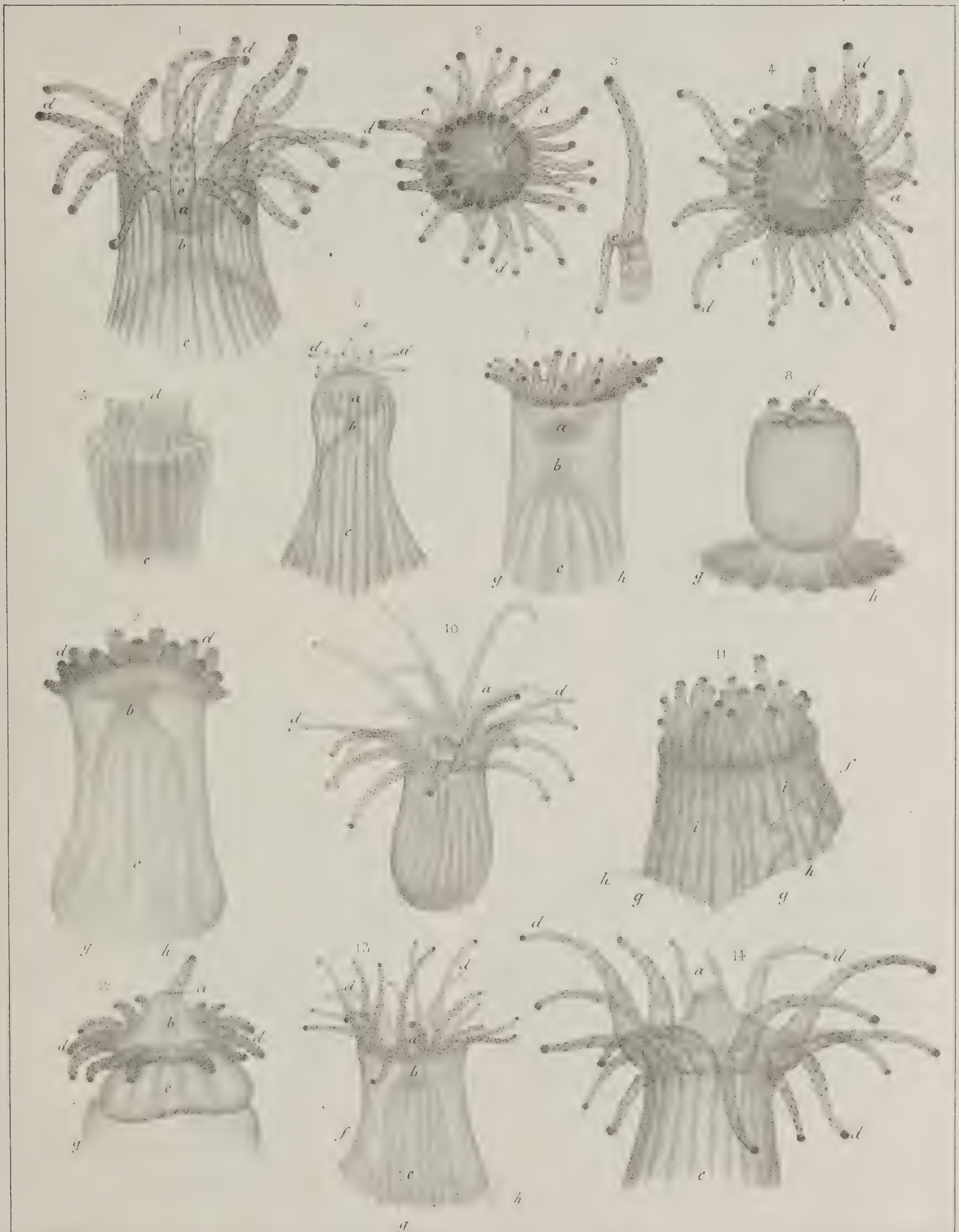


A. Sonrel, on stone from nat.

Printed by Tappan & Bradford

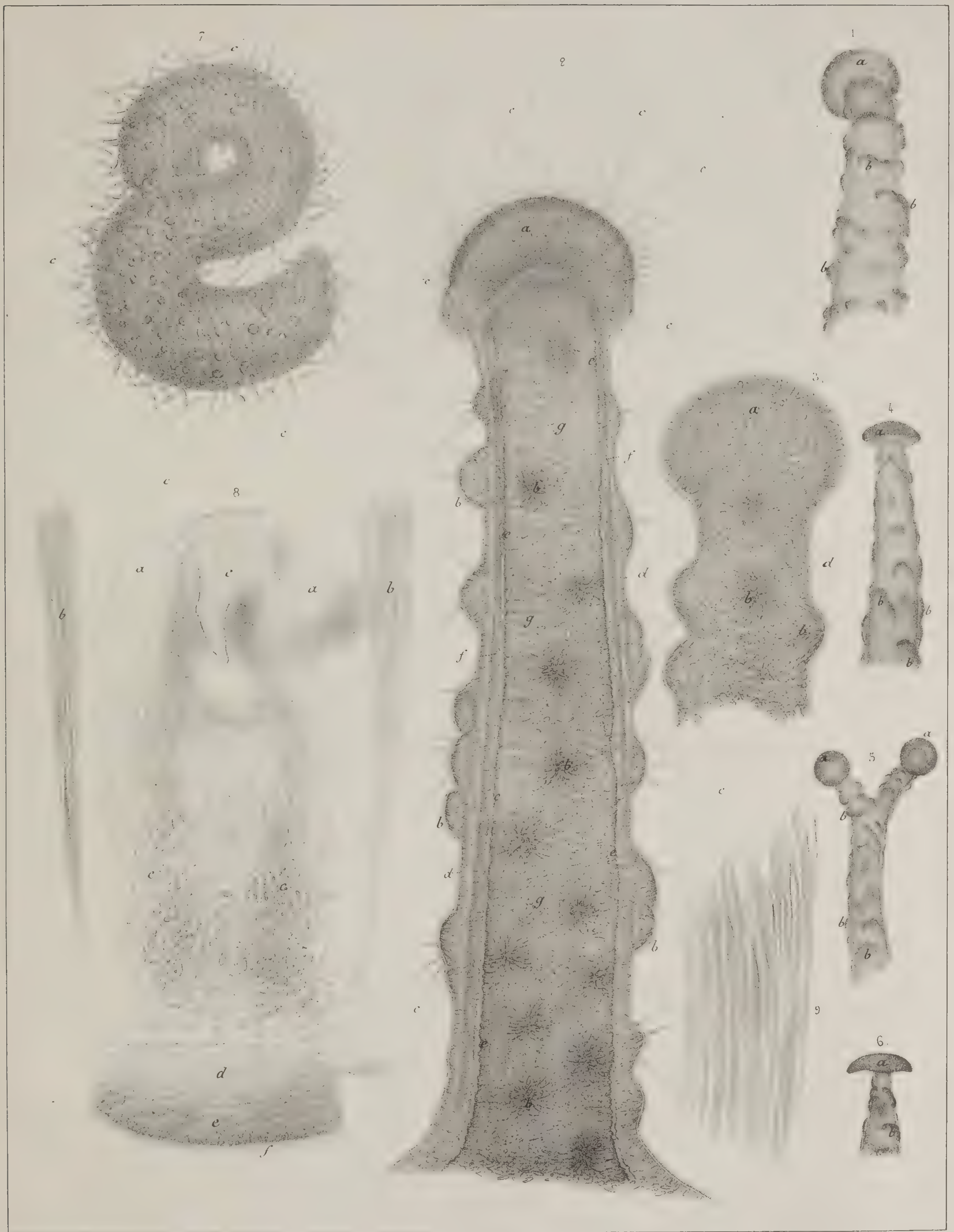


[illegible] on stone from nat

Printed by Tappan & Bradford

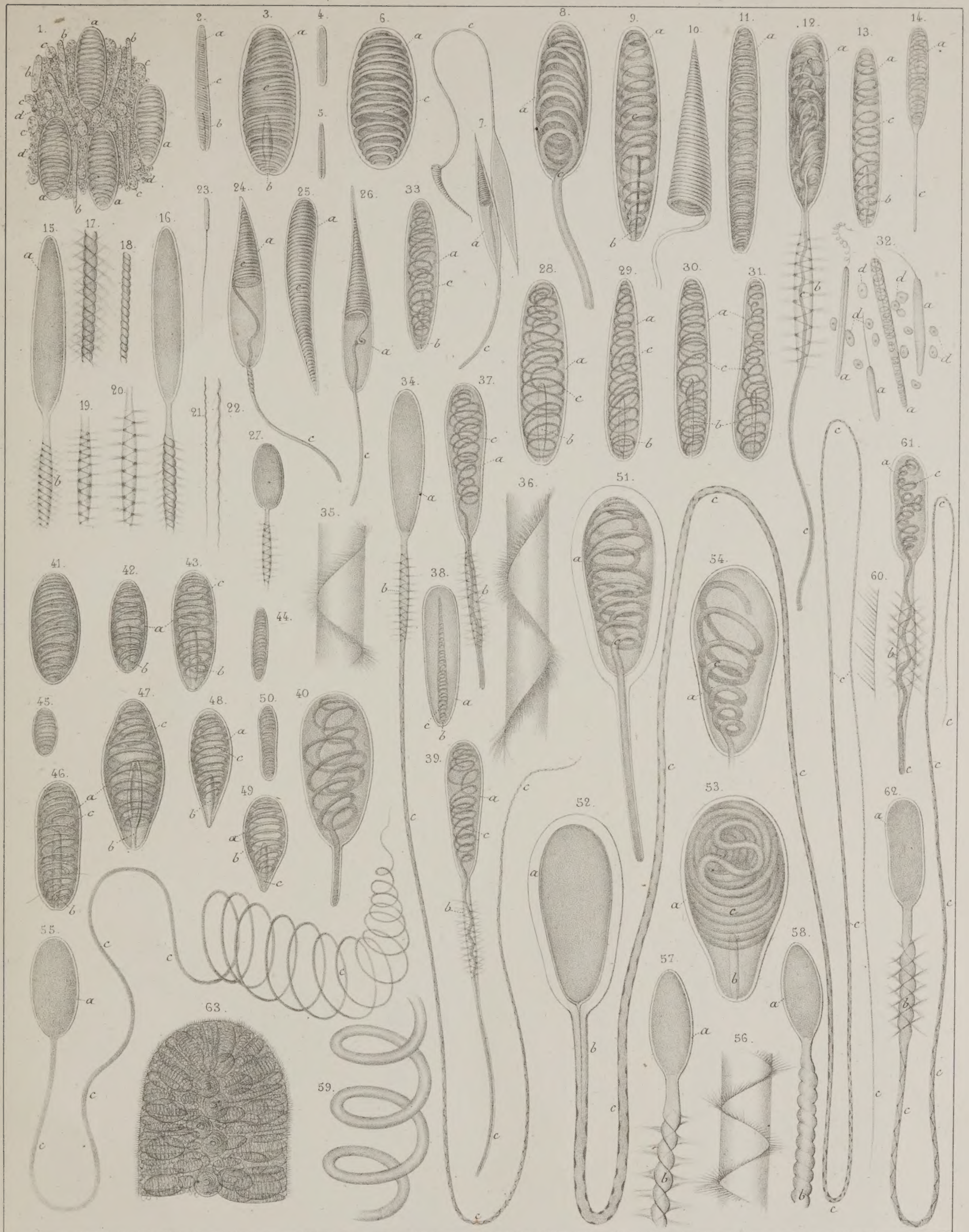
A. Sonrel on stone from nat.

Printed by Tappan & Bradford



A. Sonrel on stone from nat.

Printed by Tappan & Bradford.



A. Sonrel.

Printed by Tappan & Bradford.